

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

POND SEALING OR LINING

Bentonite Sealant

(No.)

CODE 521-C

DEFINITION

A bentonite sealant (liner) is a soil-bentonite mixture that is installed and compacted on the bottom of a pond or waste treatment facility.

Bentonite is a clay soil that, can swell up to 8 times its volume when it is unconfined and water is added to it. It is formed by the weathering of volcanic ash. It is granular when dry, but is an exceedingly sticky and slippery material when wet.

PURPOSE

Bentonite sealants are installed in ponds to reduce seepage losses to an acceptable level.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where water loss from a pond through leakage is or will be so rapid that the pond will not fulfill planned purpose, or where leakage will damage land and crops, or cause environmental problems from waste water.

This practice applies where a sufficient quantity of soil is not available on site to construct a compacted clay liner or where a soil amendment is needed to achieve seepage reduction.

CRITERIA

General

Bentonite sealants shall comply with all federal, state, and local laws, rules, and regulations. Lined structures shall meet all applicable NRCS standards. Bentonite sealants shall be compatible with their underlying natural foundation materials, according to Chapter 26, Part 633 of the National Engineering Handbook.

The bentonite sealant liner shall be protected against desiccation cracking, the effects of water surface fluctuations, wave action or any other actions that would disturb or puncture the integrity of the liner. In cases of possible disturbance, a minimum of 6 inches of compacted soil cover shall be placed over the soil-bentonite liner.

Section IV, FOTG Standard 521-C

Waste Impoundments

Design of the bentonite-treated soil for waste impoundments shall be in accordance with National Engineering Handbook Series, Part 651, Agricultural Waste Management Field Handbook, Chapter 10, Appendix 10D, and/or state regulatory requirements.

The designed liner thickness shall be calculated following laboratory analysis to determine the hydraulic conductivity ("k" value) of a treated sample.

Bentonite Properties

Bentonite for sealants shall be a sodium bentonite with a free swell of a minimum of 22 milliliters as measured by ASTM D 5890, unless laboratory tests using other bentonite types are used for design. Laboratory tests shall be performed on bentonite of the same quality and particle sizes as that proposed for the liner.

Bentonite is available from suppliers in various particle sizes for various uses, from sand to gravel. The best range of sizes of bentonite for sealing ponds and waste impoundments is sand to finer sizes. [No. 10 sieve (2.0 mm, = 0.08 inch), to finer particle sizes.]

Rate of Application

The rate of application shall be based on laboratory tests unless sufficient data are available on the field performance of previously tested soils that are texturally and chemically similar to the soils to be sealed.

In the absence of laboratory tests or field performance data on the soils to be sealed, the minimum incorporation of bentonite into each compacted layer of pervious soil shall be:

Pervious Soil Type	Minimum Application Rate of Bentonite Per 6 Inch Compacted Layer (lb/ft ²)
Clay (CL)	1.0
Sandy silt, silt (ML)	2.5
Silty sand (SM)	3.0
Sand (SW, SP)	4.0
Gravel (GW, GP)	5.0+

Thickness of Treated Liner

The finished treated liner shall be a minimum of 6 inches thick for water depths up to 8 ft., and multiples of 6 inch liner thickness shall be installed for increasing water depths; i.e. a water depth of 8.1 to 16 feet shall have a liner thickness of 12 inches. A minimum liner thickness of 12 inches is recommended for all ponds having a water surface fluctuation.

A minimum liner thickness of 12 inches is required for waste impoundments.

Total minimum thickness of treated liner plus in-place soil for stated applications:

Pond – depth to bedrock or highly permeable soil	3 feet
Waste Impoundment – depth to bedrock, no aquifer present	3 feet
Waste Impoundment – depth to aquifers yielding less than 100 gpm	15 feet
Waste Impoundment – depth to aquifers yielding over 100 gpm	25 feet

It is assumed that most bentonite-sealant liners will have a compacted thickness of 12 inches.

CONSIDERATIONS

Flattening the slopes of ponds or waste impoundments to facilitate compactive efforts during construction should be considered. The stair-step method of construction as outlined in Appendix 10D may be considered in lieu of slope flattening.

A protective compacted soil cover should be considered for protecting the soil-bentonite liner for ponds.

Consider using a flexible membrane liner for sites that have water depths greater than 24 feet.

PLANS AND SPECIFICATIONS

Plans and specifications for sealing ponds with bentonite shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

Maintenance activities required for this practice consist of those operations necessary to prevent damaging the treated soil liner. This includes, but is not limited to, excluding animals and equipment from the treated area, protection of the liner during initial filling, agitation, or pumping operations, and repair of disturbed or eroded areas.

**NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION**

APPLICATION OF BENTONITE SEALANT LAYER DURING CONSTRUCTION

The area to be treated shall be cleared of all vegetation and trash and all stones or other objects of a size that will interfere with the operation of compaction equipment.

All holes and depressions that would interfere with compaction equipment will be filled and compacted to the same requirements as for treatment layers.

An area of soil borrow to be mixed with bentonite shall be chosen. Moisture content of the borrow area shall be much drier than that required for its compaction.

Bentonite shall be distributed evenly over the borrow surface with a drill, seeder, fertilizer spreader, or by hand broadcasting. If broadcast by hand, the area will be staked or otherwise marked in grids of a convenient size to check the application rate.

The bentonite shall be thoroughly mixed into a 9-inch (.15-.23 m) layer of soil. Mixing should be with disk, rototiller, pulverizer or similar equipment. A second mixing should be carried out in a direction perpendicular to the first mixing.

Water shall be applied to the soil during disking to bring the moisture content to, or above, optimum moisture. If moisture content is too high, disking or some other effective process shall dry the soil.

Each lift of the bentonite sealant mixture shall be placed in 9-inch thickness on the area to be treated, and shall be compacted with a sheepsfoot roller. This will result in a compacted lift that is 6-inches thick. Place a sufficient number of compacted lifts until the design thickness is reached.

Each treated layer of soil shall be compacted to a dry unit weight (density) of 90 percent or more of maximum "Standard Proctor," with soil moisture at a slightly higher content than optimum. The soil will be soft and very moist at a condition above optimum moisture. The soil should be compacted with 6 passes of a 200 psi sheepsfoot roller. Half of the passes should be at right angles to the other passes, if possible.

Roll the top surface of the final lift with rubber tired equipment. The treated area should be kept moist to prevent the sealant layer from drying & cracking.

Treated areas subjected to erosion from manure pumping equipment shall be protected with a concrete liner

Treated areas shall be protected from puncture by livestock trampling. Areas near the normal water line and at points of concentrated surface flow into the pond shall be protected against erosion.

Sediment coagulating chemicals such as gypsum or iron sulfate shall not be used to clear reservoir water after treatment.

Applications shall be carried out in such a manner that erosion and air and water pollution are minimized. The completed job shall present a workmanlike finish.